

Managing Livestock Operations to Reduce Odor and Gas Emissions

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Nutrition



Management of Housing



Nutrition



Background

- HUGE amounts of ethanol co-products are available for use in the livestock industry
 - Est. 16 million metric ton in 2010
- 83% of feedlots used grain co-products in finishing diets (Vasconcelos and Galyear, 2007)
- Inclusion rate of distillers' co-products in feedlot diets ranges from 5 to 50% (Vasconcelos and Galyear, 2007)
- Optimal ADG and feed efficiency are achieved when wet distillers grains with solubles (WDGS) are included at 30% of the diet dry matter in dry-rolled corn-based diets (Erickson et al., 2007)
- Because of nutrient composition of distillers' co-products, their use in feedlot diets may negatively impact environment



Objective

- To determine if cattle fed diets containing 20 – 60% WDGS would excrete more N, P, and S, and less starch than cattle fed dry rolled corn, resulting in increased concentration of odorous compounds in cattle manure.



Results of feeding WDGS to feedlot cattle

- As the concentration of WDGS increased from 0 to 60% of diet DM, the following decreased linearly ($P < 0.05$):
 - Total VFA
 - Propionate
 - Butyrate
 - Isocaproate
 - L-lactate
- As the concentration of WDGS increased from 0 to 60% of the diet DM, the following increased linearly ($P < 0.05$):
 - Total and urinary P excretion
 - Total and urinary N excretion
 - Total S excretion
 - Caproate
 - Heptanoate
 - Isobutyrate
 - Isovalerate
 - Phenol
 - Ammonia
 - pH

Conclusions

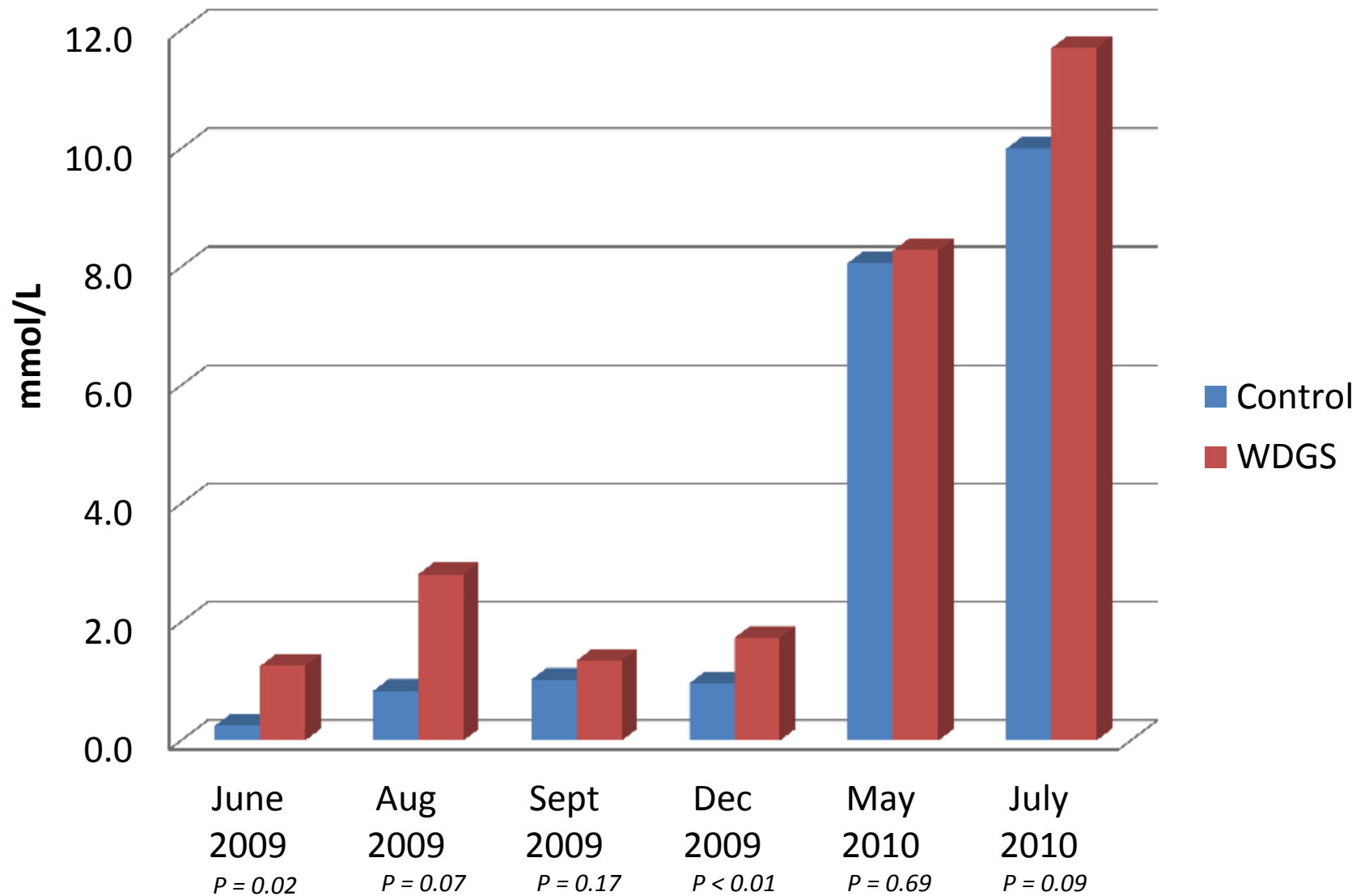
- Feedlot cattle fed increasing amounts of WDGS had increased P, N and S intake and excretion.
- Increased P concentration in livestock waste will increase the amount of land necessary to utilize manure P.
- Because of high urinary P excretion, producers should consider environmental implications of liquid runoff from the feedlot surface as well as solid manure when WDGS are fed to feedlot cattle.
- The increase in total N and S excretion contributes to the production of odorous compounds (primarily long- and branched- chain VFAs, and phenol), and may increase ammonia and hydrogen sulfide emissions from the feedlot.

Feedlot surface study (June 2009 – July 2010)

- Determine if ammonia and hydrogen sulfide emissions from feedlot surface are greater when cattle are fed diets containing WDGS compared to corn diets.
- Determine spatial variability of manure nutrients (N, P, K) and odorous VOC in feedlot pens when cattle are fed diets containing WDGS.



Ammonia Concentration



Future Nutrition Projects

- Combinations of feed ingredients that can be used with or in replacement of WDGS to reduce gas and odor emissions
- Nutrient balance studies followed by validation on feedlot surface



Housing Management



Deep-bedded monoslope barns

- Growing interest in Quad-State Region (NE, IA, MN, SD)
- Primary advantages over open lots is management of cattle and labor and complete containment of manure
- East-west orientation with southern exposure
- Feed bunks on both sides
- Natural ventilation
- Curtain-sided on north side
- Pen size: 80' x 100'
- Stocking density: 35-50 ft²/hd



Objectives



1. Determine spatial distribution of NH_3 in air samples collected from pen surface of BDMF
2. Determine spatial distribution of volatile organic compounds (VOC) in bedded pack material in BDMF
3. Characterize bedded pack during various season and determine effect of environmental factors on NH_3 concentration and VOC in BDMF
4. Determine nutrient composition of bedded pack material in BDMF
5. Determine *E. coli* O157:H7 occurrence and generic *E. coli* concentrations in bedded pack material in BDMF

Results

- High spatial variability in steady-state NH_3 concentration in air samples collected from pen surface of BDMF
- Areas of high NH_3 concentration were the result of recent urination and therefore occur randomly throughout the pen
- An apparent baseline NH_3 concentration was reached 4 – 7 hr after cattle left the pen
- Odorous VOC were most highly concentrated in transition and concrete areas of the pen and lowest in bedded pack material
- Concentration of ammonia on feedlot surface of BDMF increased as ambient air and pack temperature increased and moisture content decreased.

Results

- pH and depth of the bedded pack were poorly correlated to ammonia concentration in air samples collected from the pen surface of BDMF
- Temperature, moisture, pH, and depth of the bedded pack were poorly correlated to concentration of odorous VOC
- Nutrient composition of bedded pack material was similar to open lot feedlot, except for high volatile solids content (80%)
- E. coli O157:H7 and generic E. coli can occur at high levels in the bedded pack material, and vary with differences in ambient seasonal temperatures

Implications

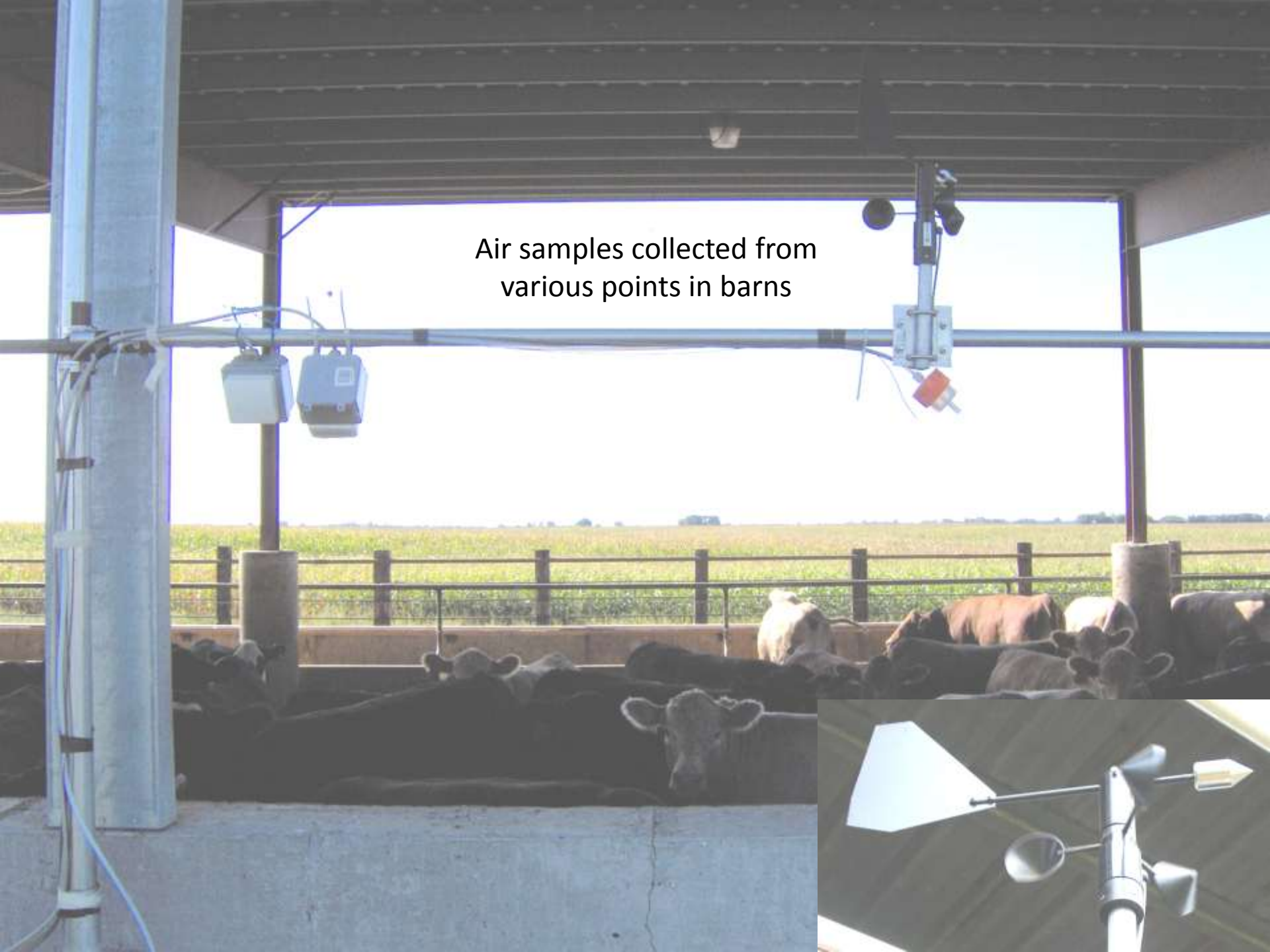
- Priority should be given to NH_3 and *E. coli* mitigation strategies in BDMF during the hot months
- Due to the random excretion of urine throughout the pen, location-specific mitigation strategies will not effectively reduce NH_3 concentration in BDMF
- Frequent cleaning of the area around the bedded pack should reduce concentration of odorous VOC
- Because of the high volatile solids content, the manure/bedding material generated in BDMF may have additional value beyond use as fertilizer, possible for combustion

Future Projects

Lab-scale evaluation of bedding materials

- Water holding capacity – Jeremiah Davis and Jody Purswell
 - Corn stover, bean stover, paper, wood chips/shavings, corn cobs, switch grass, wheat straw
- Simulated bedded packs in calorimeters
 - NH_3 , H_2S , CH_4 , CO_2 , VOC, *E. coli*, pack temp, pH, DM
 - Crop-based bedding materials
 - Wood-based bedding materials
 - Corn stover + crop-based bedding materials
 - Corn stover + wood-based bedding materials
 - Use of corn stover during various seasons
 - Use of alum to reduce ammonia emissions from bedded pack

Air samples collected from
various points in barns



Instrument trailer set up
on north side of barn



Air sampling equipment in the trailer will measure NH_3 , H_2S , CO_2 , CH_4 , and PM





Questions?

